

A NEW FORAMINIFER FROM THE MIDDLE EOCENE OF PAPUA NEW GUINEA

by C. G. ADAMS and D. J. BELFORD

ABSTRACT. *Reticulogyra mirata*, a miliolacean with some unusual morphological characters, is described from the Chimbu Limestone of Papua New Guinea.

THE stratigraphy and foraminifera of the Eocene/Oligocene Chimbu Limestone, Papua New Guinea, were described by Bain and Binnekamp in 1973. While their work was in press we noticed that a rather unusual foraminifer, not mentioned by Binnekamp in his faunal description, occurred through some 12 m of the Middle Eocene part of the 300 m thick sequence in the Chimbu Gorge. Since few limestones of Middle Eocene age have as yet been described from the Malay Archipelago and the western Pacific, the discovery of a new species is not particularly surprising. It is, however, unusually interesting because its short range and striking appearance could make it a valuable marker fossil in this part of the Indo-Pacific region.

The Chimbu Limestone forms a prominent scarp on the western limb of the Yaveufa Syncline and crops out over a distance of about 1 km along the Chimbu River near Kundiawa (text-fig. 1). As the succession was described in some detail by Bain and Binnekamp (1973) only the lower part is figured here (text-fig. 2). *R. mirata* occurs in samples 20NG 0094-0099, in a hard, grey, dense limestone, unsuited to the extraction of foraminifera which have, therefore, to be studied by means of random thin sections. Other foraminifera present in these samples were identified by Binnekamp as *Fasciolites* cf. *elongata* d'Orbigny, *Nummulites javanus* Verbeek, and *Dictyoconus chimbuensis* Binnekamp, an assemblage clearly indicative of the Middle Eocene. Numerous small miliolids are also present, as is a new flabelliform larger foraminifer referred to later. The general aspect of the assemblages in the six samples studied suggests deposition in fairly shallow water under low energy conditions.

The holotype and figured paratypes are deposited in the Commonwealth Palaeontological Collections, Bureau of Mineral Resources, Canberra, under numbers CPC 18101 to CPC 18117. Unfigured paratypes are deposited in the British Museum (Natural History).

SYSTEMATIC PALAEOLOGY

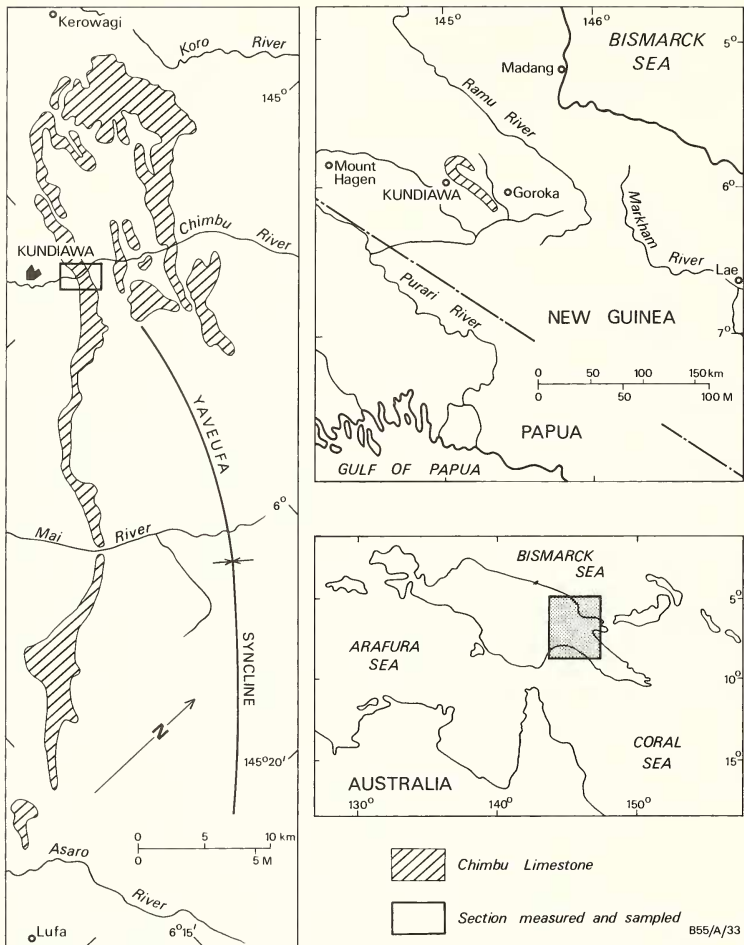
Family MILIOLIDAE

Subfamily FABULARINAE Ehrenberg, 1839

Genus RETICULOGYRA nov.

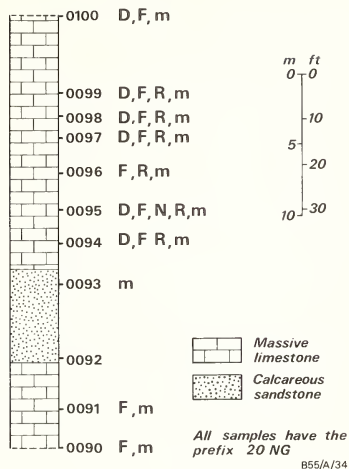
Diagnosis. A planispirally coiled miliolacean possessing short transverse and parallel (i.e. normal and parallel to the septa respectively) subepidermal partitions throughout most of the test.

Derivation of name. From the Latin, meaning netted spire.



TEXT-FIG. 1. Locality maps showing position and area of outcrop of the Chimbu Limestone.

TEXT-FIG. 2. Stratigraphical section through the lower part of the Chimbu Limestone in the measured section showing sample positions and principal elements of the foraminiferal fauna in each sample. D=*Dictyoconus chimbuensis*; F=*Fasciolites* cf. *elongatus*; N=*Nummulites javanus*; R=*Reticulogyra mirata*; m=miliolids.



Reticulogyra mirata sp. nov.

Plate 26, figs. 1-10; text-figs. 3, 4

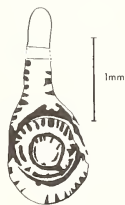
Diagnosis. As for the genus.

Derivation of name. From the Latin, meaning to be wondered at.

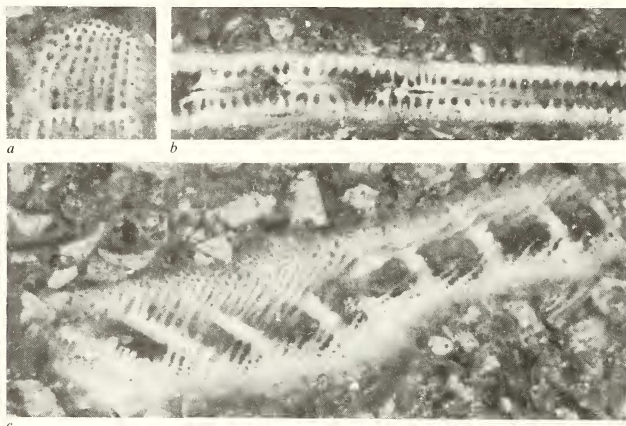
Material. Hundreds of specimens in random thin sections of limestone.

Description. Test porcellaneous, laterally compressed or subspherical chambers arranged in a planispiral coil of two to three whorls with five and a half to seven chambers in the last whorl. In some forms the final chamber shows a tendency to flare or to become uncoiled (Pl. 26, fig. 5; text-fig. 3). Short transverse and parallel subepidermal partitions extend into each chamber lumen from the third onwards, the former usually being both thicker and slightly deeper than those parallel to the

TEXT-FIG. 3. Outline drawing of an off-centre axial section of *Reticulogyra mirata* showing a strongly compressed and flared terminal chamber. Sample NG 0095.



septa; they produce a pitted effect when seen in tangential sections just cutting the test's surface (Pl. 26, fig. 10; text-fig. 4a). These partitions may be visible externally as a reticulum in matrix-free individuals since the outer wall is very thin. All but the first few chambers possess a basal wall which is usually thickest in the median plane and occasionally gives the chambers an angular appearance when seen in thin section (Pl. 26, fig. 1). The proloculus is spherical, subspherical, or irregular, and is followed



TEXT-FIG. 4. Photographs of specimens on surface of polished blocks using reflected light. All from sample NG 0095. *a*. *Reticulogyra mirata*. Tangential section through coil showing longitudinal and parallel subepidermal partitions forming a reticulum, $\times 33$. CPC 18101. *b*. Gen. et sp. indet. Sagittal/oblique section through flared portion of test showing septa and subepidermal partitions, $\times 22$. CPC 18102. *c*. Gen. et sp. indet. Semi-equatorial section through flared portion of test showing septa and the reticulum formed by the subepidermal partitions, $\times 5$. CPC 18103.

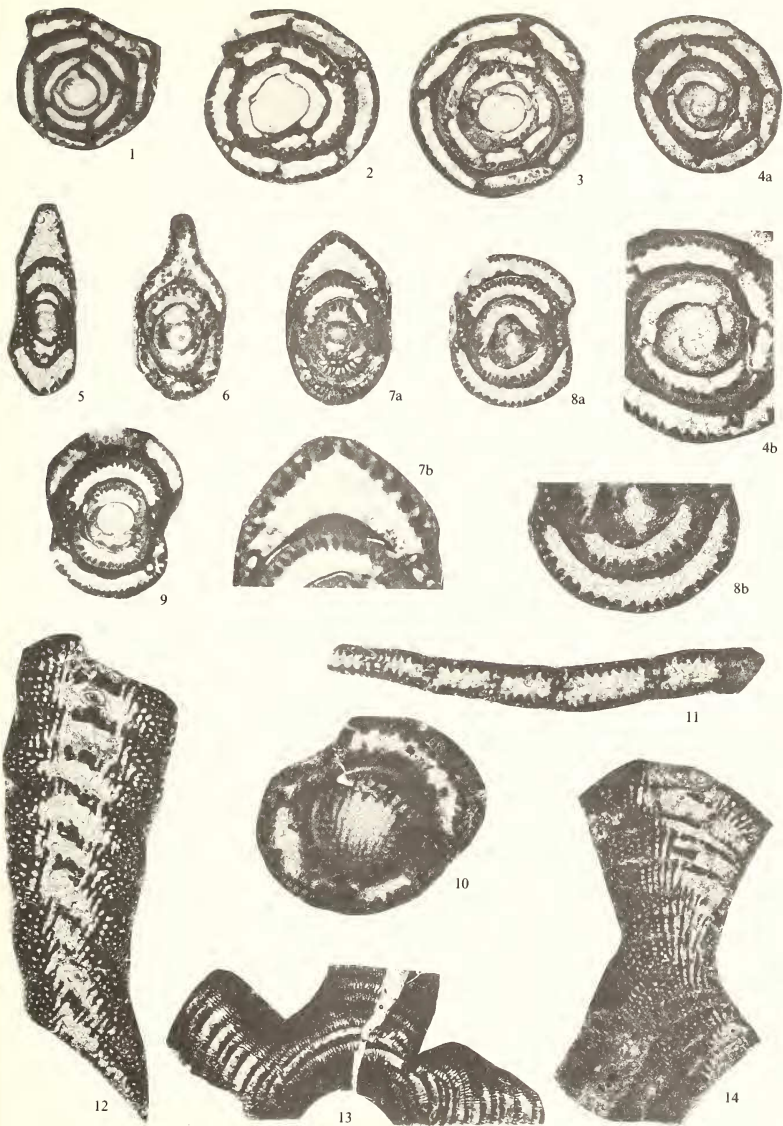
EXPLANATION OF PLATE 26

All figs. $\times 20$ approx. unless otherwise stated.

Figs. 1-10. *Reticulogyra mirata* gen. et sp. nov. 1-4, transverse equatorial sections showing planispiral coil, septa, and variation in size and shape of proloculus. In 1 the basal layer gives the chambers an angular appearance; 3, holotype (CPC 18106); 4b ($\times 32$), enlargement showing parallel subepidermal partitions. 5-9, axial or near axial sections showing variation in shape; 7b and 8b ($\times 42$ and $\times 30$), enlargements showing basal wall (7b) and transverse partitions more clearly; 10 ($\times 32$), tangential section cutting surface of an inner whorl and showing reticulum produced by intersection of parallel and transverse subepidermal partitions.

Figs. 11-14. Either the microspheric form of *R. mirata* or an undescribed and indeterminable meandropsimid. 11 ($\times 41$), sagittal section through flared portion of test showing septa and parallel subepidermal partitions. 12-14 ($\times 25$, $\times 41$, $\times 20$), subequatorial sections through flaring individuals. All three specimens show septa, transverse and parallel subepidermal partitions as does *R. mirata*.

Figs. 1-14 registered as CPC 18104-18117. Figs. 1-4, 8, 9, 11 from sample 20NG 0098; figs. 5-7, 10, 12, 14 from sample 20NG 0095; fig. 13 from sample 20NG 0097.



ADAMS and BELFORD, *Reticulogyra mirata*

by a short tube a quarter to half a turn in length. The diameter of the proloculus ranges from 0.20 to 0.55 mm; the larger proloculi are sometimes irregular. The aperture has not been seen clearly and could be either single or multiple.

Holotype. CPC 18106; Plate 26, fig. 3, from sample 20NG 0098.

Measurements. Max. diameter 0.18 mm, min. diameter 0.17 mm. The microspheric generation has not been seen.

Remarks. *Reticulogyra* is difficult to place in any miliolid family as currently defined since no other genus has both transverse and parallel subepidermal partitions. Indeed, in this respect its structure resembles that of some members of the subfamily Dicyclininae (Lituolacea) from which group it is, however, excluded by the possession of a basal wall, a feature believed to be confined to porcellaneous foraminifera. The only similar genus within the subfamily Fabularinae is *Raadshoovenia* van den Bold, but this has a milioline coil and lacks parallel partitions. *Cuvillierinella* Papetti and Tedeschi (1965), a Cretaceous genus, although described as having a planispiral initial coil, clearly begins with a milioline coil which quickly becomes planispiral (Papetti and Tedeschi 1965, figs. 2a, b, 4c, d); it also lacks parallel partitions. *Taberina* Keijer, a soritid, is planispiral then uncoiling and has incomplete transverse interseptal partitions and interseptal pillars.

Although Bain and Binnekamp (1973) mention only *Dictyoconus*, *Fasciolites*, and *Nummulites* from the samples in which *Reticulogyra* occurs, another important genus is also present (Pl. 26, figs. 11–14; text-fig. 4b, c). Like *Reticulogyra*, it possesses both longitudinal and transverse subepidermal partitions and appears to be porcellaneous. The adult test is flabelliform and comprises some nine to sixteen chambers. The most complete individuals so far obtained range from 8 to 11 mm in length and 0.35–0.50 mm in thickness. One individual (Pl. 26, fig. 13) is at least 10 mm wide. The transverse partitions are thicker and more widely spaced than those parallel with the septa. Unfortunately, we have not seen the initial stage of this taxon and cannot therefore assign it to an existing genus or describe it as new. It may, just possibly, be the microspheric form of *Reticulogyra*, although its flabelliform habit suggests that it is more probably a meandropsinid, possibly related to *Saudia*.

Wall structure. When viewed in thin section (e.g. Pl. 26, figs. 7b, 8b), the walls of the foraminifera described here bear a striking resemblance to that of *Austrorillina* Parr. One of us (C. G. A.) has long been puzzled by the development of the alveolar wall in this particular genus since it appeared to serve no structural purpose or to offer any selective advantage. It could hardly have been primarily intended to confer additional structural rigidity since species of *Triloculina* (normal milioline wall) of similar shape and size inhabited the same environments successfully. Physiologically, an alveolar wall seems actually to be disadvantageous since it could only impede the free internal streaming of cytoplasm. The porcellaneous wall of *R. mirata*, while structurally slightly different from that of *Austrorillina*, appears to offer the same physiological disadvantage while similarly lacking any primary structural advantage; other calcareous foraminifera of similar shape and size were perfectly successful without this structural modification. *A. howchini*, the last member of the *Austrorillina* lineage, when viewed in reflected light, is seen to have an outer wall which is so thin that the internal structures can be seen through it (Adams 1968, pl. 2, figs. 1, 2).

We think that the same is true of *Reticulogyra*. Because neither genus possesses openings (other than the main aperture) to the exterior, the thinning of the wall cannot have been intended to permit cytoplasm to leave the test. If the modification was neither to strengthen the wall nor to let anything escape through it, then its purpose was presumably to allow something to enter while maintaining the original rigidity: we suggest that this something may have been light, and that the ridges formed between the alveolae maintained the original strength of the test. In this connection, it is worth noting that Lee and Zucker (1969, p. 75) observed that in living *Archaias* the algal symbionts appeared to be concentrated in window-like areas in the test wall, while Ross (1972) noted that the outer walls of the lateral chamberlets in *Marginopora vertebralis* served as calcite windows for the symbionts.

Austrotrillina modified its shell continuously during the 18 million years or so of its existence (Early Oligocene to early Middle Miocene), and then became extinct for no apparent reason. So far as we know *Reticulogyra* enjoyed only a very brief existence during the Middle Eocene. They both occupied tropical shallow-water carbonate environments which are not known to have been undergoing any profound changes when these genera became extinct. We therefore suggest that *Austrotrillina* and *Reticulogyra* may have modified the original miliolacean wall in order to provide better illumination for symbionts. If, after modifying the wall, they became dependent upon particular symbionts for the maintenance of their metabolism, then the extinction of these symbionts would necessarily have encompassed the extinction of the host species without any change being visible in the sedimentary environment.

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